

Common Methodological Approaches and Review Types in Undergraduate STEM Education Research

This handout shares some of the methodological approaches and review types that are most commonly found in the undergraduate STEM education research.

Methodological approaches are related to the overall methods of the synthesis, both in the literature included and the methods used to synthesize the literature’s findings. We look closely at three main methodological approaches: qualitative synthesis, meta-analysis, and mixed methods synthesis.

Review types are related to the design of the stages and steps that are used in conducting the review or synthesis. Some review types can be used with different methodological approaches and others are methodologically specific. Here we will look at thematic synthesis (which is the review type we use), systematic review, and scoping review.

These are **not** all the ways of conducting reviews and synthesis that exist but are some of the most commonly found in the literature. It is important to understand that they all have the **goal of bringing together the results from multiple studies**. However, they differ in how they pursue this goal.

METHODOLOGICAL APPROACHES

Table 1. Comparison of Methodological Approaches

	Qualitative Synthesis	Meta-Analysis	Mixed Methods Synthesis
Type of Literature	Qualitative	Quantitative	Mixed methods
Purpose	To synthesize qualitative primary-level studies; To develop new, higher-level understandings of the literature, and/or to generate theory or conceptual models	To confirm a hypothesis or theory through the synthesis of quantitative primary-level studies; To estimate effect sizes and explore variations	To provide a robust understanding of a research problem through the integration of findings from qualitative, quantitative, and mixed methods primary-level studies
Search & Selection	Can use systematic methods (design dependent); Employs critical appraisal of literature	Uses systematic methods; Assesses variability between studies; Employs quality appraisal of literature	Uses systematic methods; Employs critical/quality appraisal of literature
Analysis	Uses qualitative methods	Uses statistical methods	Uses mixed methods; Uses qualitative and quantitative methods that are later integrated

Seminal Works	Noblit & Hare (1988) Booth et al. (2016)	Hunter & Schmidt (1982) Cordray, Harris, & Gilbert (2007)	Heyvaert, Hannes, & Onghena (2017)
Examples in STEM Undergraduate Education	Duncan et al. (2023) Tarlochan et al. (2025)	Bradford et al. (2021) Cromley et al. (2023)	Borrego et al. (2009) Kajfez & Creamer (2014) Meduri et al. (2025)

Qualitative Synthesis versus Meta-Analysis

The main differences between qualitative synthesis and meta-analysis are related to the methods used in the literature to be analyzed and methods used to conduct the studies.

- Qualitative syntheses synthesize studies conducted using qualitative / interpretive methods and use these same methods to conduct the analysis and develop their findings.
- Meta-analyses synthesize studies conducted using quantitative methods / experimental design and use these same methods to conduct the analysis and develop their findings.

Qualitative Synthesis versus Mixed Methods Synthesis

There is some overlap in these two methodological approaches, since both include qualitative methods both in the literature analyzed and the methods used to conduct the syntheses.

In addition, a mixed methods synthesis also includes:

- Literature that used quantitative methods and uses quantitative methods to conduct analysis.
- Mixed methods to integrate the qualitative and quantitative strands of the synthesis.

REVIEW TYPES

Table 2. Comparison of Review Types

	Thematic Synthesis	Systematic Review	Scoping Review
Type of Literature	Qualitative; May include others	Qualitative, quantitative, or mixed methods	Qualitative, quantitative, or mixed methods
Purpose	To answer a synthesis question through the synthesis of qualitative primary-level studies by identifying patterns and developing themes	To provide a comprehensive overview of a set of high quality research literature	To map key concepts in a complex area that has not been reviewed comprehensively before; To assess the feasibility of a full systematic review
Search & Selection	Uses systematic methods; Assesses quality; Employs critical appraisal of literature	Uses systematic methods; Assesses quality; Employs critical appraisal of literature	Uses systematic methods; Does not employ critical appraisal of literature

Analysis	Uses thematic analysis	Summarizes literature findings	Uses preliminary literature assessment; Charts key concepts
Seminal Works	Thomas & Harden (2008)	Cochrane (1972) Borrego, Foster, & Froyd (2014)	Arksey & O'Malley (2002) Pham et al. (2014)
Examples in STEM Undergraduate Education	Ong et al. (2020) Smith & Van Aken (2020)	Chestnut & Johnson (2025) Dogucu et al. (2025)	Denton & Borrego (2021) Hackerson et al. (2024)

Thematic Synthesis versus Systematic Review

The main differences between thematic synthesis and systematic review lie in their literature selection and analysis methods:

- Thematic synthesis uses systematic methods for the search and selection of the literature and uses thematic analysis to conduct its analysis.
- Systematic review uses systematic methods to identify its literature and may (or may not) use formal analysis methods to develop its findings.

Thematic Synthesis versus Scoping Review

Both thematic synthesis and scoping review use systematic methods to identify the literature. The main differences between them lie in the depth of the results developed and the use of critical (or quality) appraisal:

- A thematic synthesis develops in-depth findings using thematic analysis methods and uses critical appraisal of the literature so that only high quality research is included.
- A scoping review develops an overview of the existing literature on a topics and maps the key concepts and main sources of evidence. It does not critically appraise the literature, so the quality of the literature included is not ensured.

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